PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-329669

(43)Date of publication of application : 30.11.2000

(51)Int.Cl. G01N 3/10

(21)Application number : 11-135700

(22)Date of filing : 17.05.1999

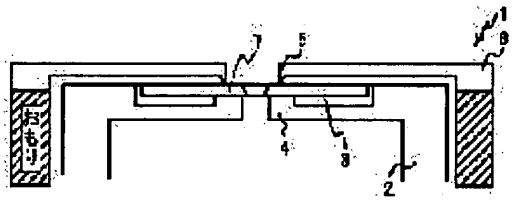
(71)Applicant : NIKON CORP

(72)Inventor : TAKAHASHI SHINICHI

(54) SELF-SUSTAINED MEMBRANE EVALUATION APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a self-sustained membrane evaluation apparatus by which a membrane on a transfer mask blank for a charged particle beam can be evaluated with good accuracy by a method wherein a pressure part comprising the fulcrum of a load is provided in a position corresponding to the center of a holding part formed of a clearance groove formed in the opening end part of a pressure regulating chamber.



SOLUTION: A sample holding mechanism 1 is provided with a ring beltlike holding part 4 formed of a ring beltlike clearance groove 3 which is formed in the opening end part of a pressure regulating chamber 2. The sample holding mechanism is provided with a pressure part 6, comprising a plumb hob, which comprises an edge-shaped tip 5 arranged in a position corresponding to the holding part 4. In addition, a straight line which connects the central position of the holding part 4 to the edge-shaped tip 5 is made identical to the direction of gravity so that an uneven load on a sample 7 is suppressed. The width of the holding part 4 is made narrow as far as possible, and the sample 7 is pressed by the edge-shaped tip 5. As a result, a contact area with the sample 7 is small, and the deformation of the sample 7 is not caused. A load which is applied to the sample 7 is set so as not to move the sample 7.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the evaluation system of the independence thin film (henceforth a membrane) of transfer MASUKUBU Ranks for charged particle beam exposure used for a charged particle beam reduction transfer device.
[0002]
[Description of the Prior Art]In recent years, in order to raise the resolution of the optical system restricted by the diffraction limit of light in connection with the minuteness making of a semiconductor integrated circuit element, the exposure system (lithography technology) which uses charged particle beams (only henceforth a charged particle beam), such as X-rays, an electron beam, and an ion beam, is developed. Since the electron beam lithography which forms a pattern also in it using an electron beam can extract the electron beam itself even to several angstroms (angstrom), the big feature is that it can form 1 micrometer or the minute pattern not more than it.
[0003]However, since it was a method of the picture drawn without lifting the brush from the paper, the more it became a minute pattern, the more, the conventional electron-beam-lithography method had to draw with the extracted electron beam, and its drawing time was long and it was not used for exposure of the wafer for mass production from a viewpoint of a device production cost. Then, the transfer mask which has a predetermined pattern is irradiated with an electron beam, and the charged particle beam reduction transfer device which carries out reduction transfer of the pattern in the irradiation area with a projection lens at a wafer is proposed.
[0004]In order to project a circuit pattern, the transfer mask in which the circuit pattern was drawn is required. As are shown in drawing 7 (a), and a breakthrough does not exist but it is indicated in drawing 7 (b) as the dispersion penetration transfer mask 21 in which the scatterer

pattern 24 was formed on the membrane 22 as a transfer mask, The dispersion stencil transfer mask 31 in which the breakthrough pattern 34 was formed in the membrane 32 which has the thickness of the grade scattered about in an electron beam is known.

[0005]These are classified by the border area where a pattern does not exist in the small regions 22a and 32a of a large number provided with the pattern which should be transferred to an induction substrate on the membrane 22 and 32, respectively, and the supports 23 and 33 are formed in the portion corresponding to a border area. Transfer MASUKUBU Ranks for dispersion stencil masks is manufactured by the manufacturing method indicated to JP,10-106943,A, for example.

[0006]In this manufacturing method, the SOI (Silicon on Insulator) board which consists of a support silicon substrate, a silicon oxide layer, and a silicon active layer is prepared, The SOI substrate which consists of the support silicon substrate, silicon oxide layer, and silicon active layer (boron diffusion) which were manufactured by the silicon active layer by diffusing boron (a thermal diffusion method or ion implantation) is used. The SOI substrate which consists of this support silicon substrate, a silicon oxide layer, and a silicon active layer heats a silicon substrate and the substrate which oxidizes the surface of a silicon substrate and consists of a silicon oxide layer and a silicon layer to the temperature of 100 times more than 1000, and is performing lamination by thermofusion.

[0007]Therefore, when it becomes ordinary temperature, the heat remaining stress of compression to a silicon active layer (a silicon substrate becomes a silicon active layer by grinding and polish) will arise from the difference in the coefficient of thermal expansion of a silicon oxide layer and a silicon substrate. Therefore, when this silicon active layer is made into silicon membrane, it will bend.

[0008]On the other hand, when the tensile stress of the membrane was too large and a pattern is formed in the membrane, modification arises. Therefore, it is necessary to evaluate the internal stress of a membrane, and the evaluation art is very important art. The bulge method has been used as a method of measuring the internal stress and Young's modulus of this membrane. Hereafter, the experiment principle of the bulge method is explained briefly.

[0009]The bulge method can draw simultaneously the remains internal stress and Young's modulus of a thin film from the deformation of a thin film when it pressurizes. When the energy of the pressure which applied this to the membrane expresses this which can be expressed with the sum of the energy resulting from the internal stress of a membrane, and the strain energy which produced the pressure according to the modification to depend, alias a beam, with a formula, it is as follows.

[0010]

[Equation 1]

$$P = \frac{C_1 \sigma t h}{a^2} + \frac{C_2 E t h^3}{a^4}$$

E：ヤング率　　P：圧力
σ：内部応力　　h：膨らみ量
C1：定数
C2：定数
t：膜厚
a：メンブレンサイズ

[0011]The first paragraph of the right-hand side shows the energy by internal stress, and the strain energy according [the second paragraph] to modification, and the left side shows application-of-pressure energy. C_1 and C_2 are constants decided from the membrane shape and the POWASSON ratio of an independence thin film. As shown in a formula, internal stress and Young's modulus can be drawn by measuring the amount of swellings of a thin film when changing a pressure.

[0012]There are so few amounts of swellings qualitatively that Young's modulus is high, it swells, so that internal stress is high similarly, and there is little quantity. Drawing 3 is a schematic diagram of the conventional independence thin film evaluation system. The independence thin film evaluation system 10 had the opening 11 in the position equivalent to an evaluation sample installed part, and it is provided with the pressure regulation chamber 15 provided with the pressure regulation part 13 and the pressure gauge 14, and the amount measurement mechanism 16 of swellings near [opening 11] the while it is provided with the sample maintaining structure 12.

[0013]The sample maintaining structure 12 is a mechanism in which the sample 17 is carried out for adjusting and putting the screw 30 by the **** board 19 and the open end 20 via O ring 18, and is held. The amount measurement mechanism 16 of swellings consists of a microscope with the micrometer of a palpation-type level difference measuring instrument, an interferometer, and the direction of z, etc., for example.

[0014]Drawing 4 is the (a) plan of a measuring sample, the (b) side view, and the (c) bottom view. The measuring sample 17 is manufactured using the manufacturing method indicated to JP,10-106943,A which mentioned above the membrane 9 of 2 micrometers in thickness, and 1 mm square in the central part of the chip of the outside 10 mm square started from a 3-inch silicon wafer.

[0015]

[Problem(s) to be Solved by the Invention]However, when the stress value of a sample is

measured using the conventional independence thin film evaluation system, an exact stress value cannot be measured. Drawing 5 is the figure which repeated three attachment and detachment of a sample and measured the amount of swellings to change of a pressure using the conventional independence thin film evaluation system.

[0016]When it converts into a stress value, there is variation in about 21 MPa(s), 39MPa, 45MPa, and about 20 MPa, respectively. If a pattern is formed in the membrane when a membrane has stress of 10MPa as a result of the research latest [, such as a simulation,], it turns out that modification of an about about ten-nm pattern takes place.

[0017]Compared with the photo mask used with the conventional projection aligner, the transfer mask for charged particle beams used for the new transfer method using a charged particle beam, Since the pattern accuracy of about about ten nm and position distorted accuracy are required in connection with the super-minuteness making of an integrated circuit, in the measurement reproducibility of about 20 MPa which was mentioned above, it cannot respond to evaluation of the membrane of transfer MASUKUBU Ranks for charged particle beams.

[0018]Then, this invention is made in view of such a conventional problem, and an object of this invention is to provide the independence thin film evaluation system in which evaluation with the sufficient accuracy of the membrane of transfer MASUKUBU Ranks for charged particle beams is possible.

[0019]

[Means for Solving the Problem]Since the power point 40 and the fulcrum 41 of the presser-foot board 19 have shifted as it is shown in drawing 6 which expanded sample maintaining structure of the conventional independence thin film evaluation system, as a result of examining this cause wholeheartedly, It turned out that power of the bending moment added and changed into the sample 17, and a stress value with which load stress was added to a remains internal stress value (true value) is measured in order that independence thin film 9 the very thing manufactured by modification of the sample 17 by one may also receive power of hauling.

[0020]It turned out that bundle condition of the screw 30 of the presser-foot board 19 contributes to modification of the sample 17 greatly, and worsens reproducibility of measurement. While this invention has an opening in a position which is equivalent to "evaluation sample installed part in the first place and is provided with sample maintaining structure near [the] an opening, In an independence thin film evaluation system provided with a pressure regulation chamber provided with a pressure regulation part and a pressure gauge, and the amount measuring device of swellings, An independence thin film evaluation system (claim 1) with which said sample maintaining structure is characterized by having an attaching part formed of a relief groove provided in an open end of said pressure regulation chamber

and a rear part which has a fulcrum of load in a position corresponding to the center of the attaching part" is provided.

[0021]

[Embodiment of the Invention]It explains referring to the independence thin film evaluation system of the embodiment concerning this invention hereafter. The independence thin film evaluation system of an embodiment is the same as the conventional independence thin film evaluation system except sample maintaining structure. Drawing 1 is an outline sectional view of the sample maintaining structure of the independence thin film evaluation system of the embodiment concerning this invention.

[0022]The sample maintaining structure 1 is provided with the following.

It is the ********** zona-orbicularis-like attaching part 4 by the relief groove 3 of the shape of zona orbicularis formed in the open end of the pressure regulation chamber 2.

The rear part 6 with weight which has the tip 5 of the edge shape arranged at the position corresponding to the attaching part 4.

That is, since the straight line which connects the zona-orbicularis-like the center position and the edge tip 5 of the attaching part 3 is the same as that of the direction of gravity, the uneven load to the sample 7 is controlled.

[0023]As for the width of the attaching part 3 of the shape of this zona orbicularis, it is preferred that it is 1.5 mm or less, and the narrower possible one of modification of a sample is small. Since the sample 7 is pressed down at the tip 5 of edge shape, the touch area to the sample 7 is small, and does not cause modification of the sample 7. According to this embodiment, although the edge shape tip 5 has become zona orbicularis-like, it can make the touch area to a sample small more by using three-point support shape.

[0024]The load imposed on the sample 7 imposes the load that the sample 7 does not move, also when the maximum pressure put on the sample 7 within the pressure regulation chamber 2 is put. Drawing 2 is the figure which repeated ten attachment and detachment of a sample and measured the amount of swellings to change of the pressure of each sample using the independence thin film evaluation system of an embodiment. Compared with the case where it measures using the conventional evaluation system, it turns out that reproducibility is dramatically good.

[0025]If it converts into a stress value, the reproducibility of measurement by ten measurement is suppressed within **1 MPa.

[0026]

[Effect of the Invention]Since the straight line which connects the center of a zona-orbicularis-like attaching part and the fulcrum of the load of a rear part is the same as that of the direction of gravity according to the independence thin film evaluation system concerning this invention as explained above, the uneven load to a sample is controlled.

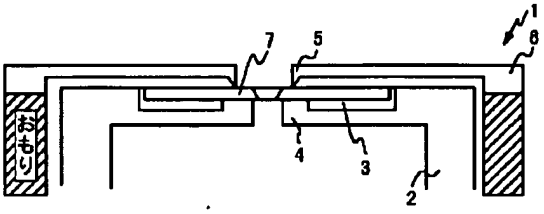
[Translation done.]

* NOTICES *

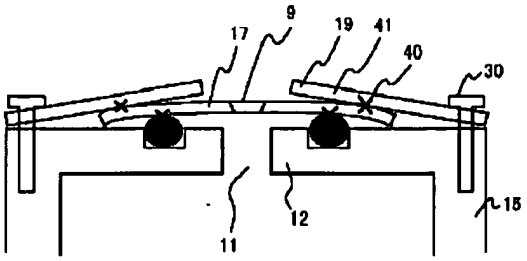
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

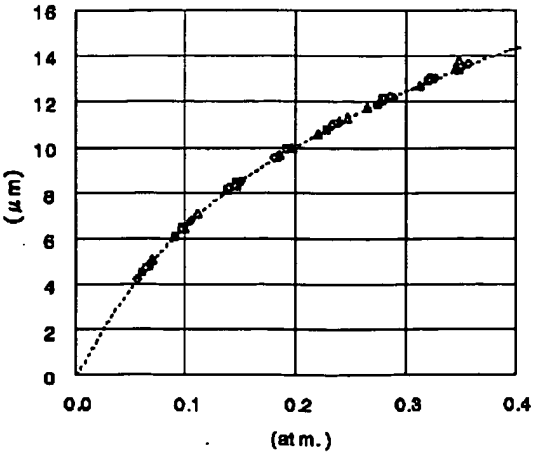
[Drawing 1]



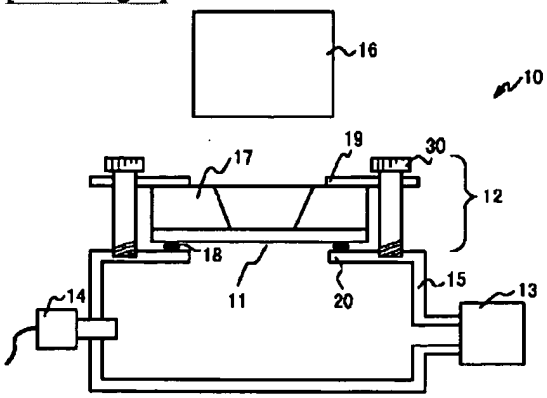
[Drawing 6]



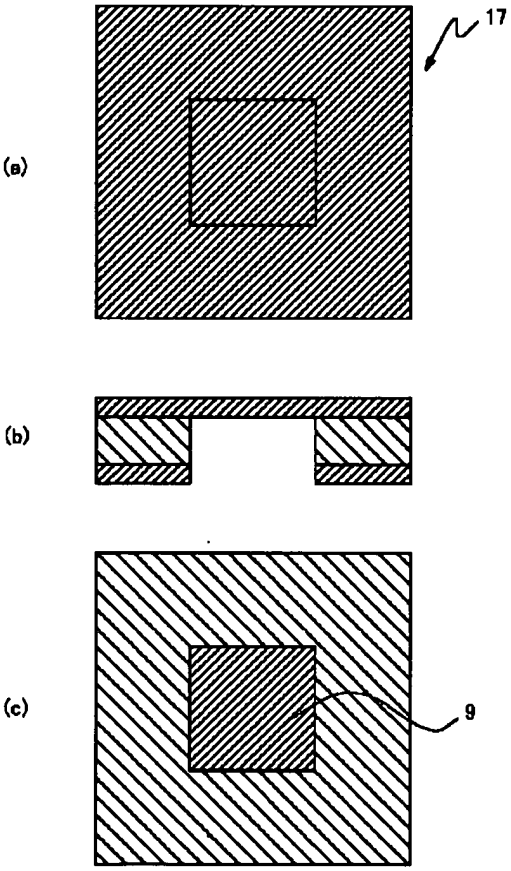
[Drawing 2]



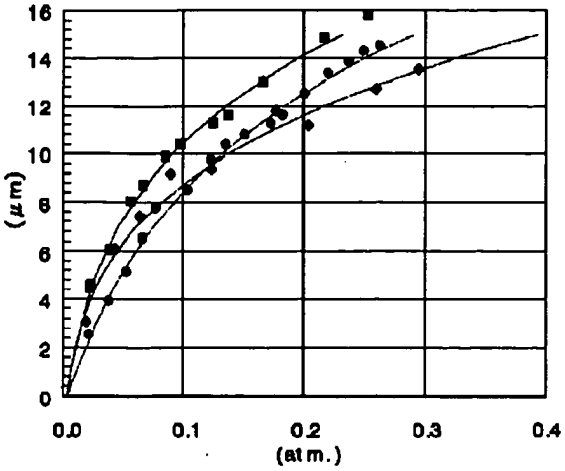
[Drawing 3]



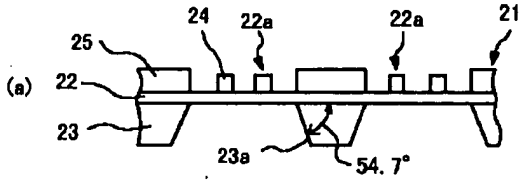
[Drawing 4]



[Drawing 5]



[Drawing 7]



[Translation done.]